REMARKS

Claims 1-71 were pending in the application. In this response, applicants amended claims 1, 20, 22, 62 and 68; and present new claim 72. As a result, claims 1-72 are presently pending.

In the March 20, 2007 non-final office action, all of the pending claims were rejected. More specifically, the status of the application in light of this Office Action is as follows:

(A) Claim 20 stands rejected under 35 U.S.C. § 112;

(B) Claims 1-41 and 62-71 stand rejected under 35 U.S.C. § 101;

(C) Claims 1-6, 11-16, 21, 42-45, 48-53, 56-59, 61-63, 65 and 67-71 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,731,996 to Gilbert ("Gilbert");

(D) Claims 1-3, 5-12, 14-20, 42-51, 53-56, 58-60 and 62-71 under 35 U.S.C. § 102(e) stand rejected as being anticipated by U.S. Patent No. 6,484,118 to Govari ("Govari");

(E) Claims 1-71 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Gilbert in view of Govari.

For the reasons discussed in detail below, applicants submit that all of the pending claims are in condition for allowance.

A. Response to Section 112 Rejection of Claim 20

The Examiner rejected claim 20 under 35 U.S.C. § 112 as being indefinite. Applicants herein amend claim 20 to resolve this indefiniteness and not for purposes of overcoming the prior art and respectfully requests that the Examiner withdraw his rejection. Further, applicants present new claim 72, which adds to claim 20 the same limitation that claims 13, 35, and 57 add to claims 12, 22, and 56, respectively. Accordingly, applicants respectfully request that the Examiner reconsider and withdraw this rejection with respect to claim 20, and allow claim 72.

B. Response to Section 101 Rejection of Claims 1-41 and 62-71

The Examiner rejected claims 1-41 and 62-71 under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Applicants herein amend claims 1, 22, 62 and 68 to replace "a computer-based method" with "a method in a computing system." Accordingly, applicants respectfully request that the Examiner reconsider and withdraw this rejection.

C. Response to Section 102(b) Rejection of Claims 1-6, 11-16, 21, 42-45, 48-53, 56-59, 61-63, 65 and 67-71 (Gilbert)

Claims 1-6, 11-16, 21, 42-45, 48-53, 56-59, 61-63, 65 and 67-71 were rejected under 35 U.S.C. § 102(b) as being anticipated by Gilbert. Applicants respectfully traverse this rejection. For the reasons explained below, this rejection is not proper because Gilbert does not disclose or suggest all of the claimed features. As a result, the Section 102 rejection of these claims should be withdrawn.

Independent claim 1 is directed to the process of receiving a set of actual measurements, each actual measurement indicative of a component of the magnetic field at each of a plurality of sensors; providing sets of reference measurements, each set of reference measurements being associated with a location such that an actual measurement from that location is expected to be a linear combination of that set; selecting the location associated with the set of reference measurements that most closely matches the received set of actual measurements; and identifying a location associated with a set of calculated measurements that most closely matches the set of actual measurements wherein the set of calculated measurements is derived from the sets of reference measurements.

Gilbert discloses a processing method and apparatus for dipole moment detection and localization. A set of actual magnetic field measurements of a magnetic dipole is collected using a plurality of sensors, and then a location for the dipole is hypothesized. In the given example (col. 2, lines 56-58), a dipole is hypothesized to exist at each point in a fixed grid encompassing the entire area covered by the sensor array. A set of predicted field measurements is determined at each of the hypothesized locations, and these predicted measurements are compared with the actual measurements. The hypothesized location whose predicted measurements exhibit the strongest correlation with the actual measurements is selected as the location of the dipole. (col. 9, lines 47-51).

Claims 1-6, 11-16, 21, 42-45, 48-53, 56-59, 61-63, 65 and 67-71 are patentable over Gilbert under Section 102 because this reference fails to teach or suggest "identifying a location associated with a set of calculated or interpolated measurements, wherein the set of calculated or interpolated measurements is derived from the sets of reference measurements." Thus, the pending claims are patentable over Gilbert. In contrast to the claimed invention, Gilbert selects from a set of hypothetical positions the position that best matches the actual measurements. In the current application, a similar result is achieved in the third step, by means not anticipated in Gilbert (see Claims 39-41). However, the identification of a location wherein the measurements are derived from the sets of reference measurements goes beyond Gilbert entirely and is not taught or suggested.

As claimed in claims 14-17 and described in paragraph 0018, the identifying element involves creating an interpolation between adjacent reference measurements, and using this interpolation to calculate expected measurements at positions not given by reference measurements. These calculations allow the simulation of an infinitely divisible field, which is used to iteratively refine an approximation with a higher precision than that represented by the reference data. As described in paragraph 0026, this technique allows the use of a dramatically smaller set of reference measurements to achieve an equivalent accuracy in prediction.

Independent claim 1 and the dependent claims thereof are further patentable over Gilbert under Section 102 because this reference also fails to teach or disclose "receiving a set of actual measurements, each actual measurement indicative of a component of the magnetic field at each of a plurality of sensors." The current application demonstrates the collection of orthogonal components of the magnetic field, which facilitates the calculation of first- and second-order derivatives of field strength in each dimension. (See paragraph 0019, describing the three columns of $\mathbf{H}_b$, each indicating the sensitivity of the measurement to one of the x, y, or z components of $\mathbf{m}_b$.) These components are used in the final step to estimate the expected measurements at points not given by reference measurements, as well as in the objective function described in paragraph 0018, in order to predict a location where the objective function will have a desired value.

Independent claims 42 and 50 and the dependent claims thereof can also be distinguished from Gilbert by this final interpolative step. Claim 62 further claims a method of calculating the position of a dipole in the presence of interference, including receiving a set of actual measurements, providing sets of reference measurements, providing a set of augmented measurements, and selecting the location associated with the set of reference measurements as augmented by the set of augmented measurements that most closely matches the received set of actual measurements. Gilbert fails to teach or disclosure the selecting element of claim 62 and therefore the Section 102 rejection should be withdrawn from claim 62 and the dependent claims thereof.

Independent claim 68 is similar to claim 62, except that it incorporates for each measurement a reliability weight rather than an augmentation factor based on expected level of interference. The Examiner suggested that the filtering steps 28 and 29 in Gilbert anticipate these claims. However, Gilbert never characterizes these steps beyond the vague label of "predetermined filter," nor is there any suggestion how or whether such a filter could be used to account for interference or sensor reliability. By contrast, the current application discloses a detailed method for integrating these effects into its calculations. Thus, Gilbert fails to teach or disclosure at least one element of independent claim 68 and the dependent claims thereof, and therefore, the Section 102 rejection should be withdrawn.

D. Response to Section 102(e) Rejection of Claims 1-3, 5-12, 14-20, 42-51, 53-56, 58-60 and 62-71 (Govari)

Claims 1-3, 5-12, 14-20, 42-51, 53-56, 58-60 and 62-71 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Govari. The Examiner asserts that Govari discloses a system for determining the position of a medical device having a sensor comprising a plurality of radiator elements which anticipates the claims. For the reasons explained below, however, applicants respectfully disagree with the Examiner.

Independent claim 1 is directed to the process of receiving a set of actual measurements, each actual measurement indicative of a component of the magnetic field at each of a plurality of sensors; providing sets of reference measurements, each set of reference measurements being associated with a location such that an actual measurement from that location is expected to be a linear combination of that set; selecting the location associated with the set of reference measurements that most closely matches the received set of actual measurements; and identifying a location associated with a set of calculated measurements that most closely matches the set of actual measurements wherein the set of calculated measurements is derived from the sets of reference measurements.

Govari discloses a method for determining the position and orientation of a sensor in a magnetic field generated by a plurality of field radiators wherein each field radiator has a plurality of radiator elements. Govari discloses a calibration step in which a sensor is moved according to the vertices of a cube, and the actual field strength at each vertex is measured and the difference between this measurement and a calculated expected measurement is stored. (col. 19, lines 17-30). One embodiment of this process involves recursive subdivision of a bounding box, wherein an intermediate point is selected between two vertices of the bounding box, a predicted measurement is calculated at that point (incorporating an expected calibration adjustment interpolated from the calibration measurements at the two known vertices), and this calculated measurement is compared with the actual measurement. If these values match within an error limit, the interpolated calibration is considered adequate and no further subdivision takes place; otherwise, the bounding box is subdivided into two new boxes, each defined by the newly measured point and one of the two original bounding box vertices, and each new box is recursively evaluated. (col. 22, line 15 through col. 23, line 5).

The mere use of subdivisible bounding boxes in this calibration step does not teach or suggest the method claimed in the current application. In Govari, bounding boxes are used to map the difference between a theoretically calculated magnetic field and empirical measurements. These boxes are subdivided to the extent that the empirical measurements do not conform to the simple gradient predicted by the theoretical calculations, in order to produce an accurate calibration map. In the current application, subdivisible bounding boxes are used to cast the reference data as an N-ary tree so that it may be quickly searched for the grid point most closely matching a set of actual measurements. (See paragraph 0017 and claims 17-19 and 39-41.) Thus, while Govari uses subdivisible bounding boxes to generate calibration measurements, the current application uses them to calculate an approximate dipole location; and while Govari uses subdivisible bounding boxes to lower the resolution of its calibration measurements, the current application uses them to increase the resolution of a time-constrained search.

Furthermore, the claims are patentable over Govari under Section 102 because this reference fails to teach or suggest each element of the claimed invention. For example, Govari discloses an iterative positioning algorithm, wherein the field strength and a Jacobian (first order derivative) are calculated at a given point, and one of various descent or convergence algorithms is used to predict a point at which the calculated measurements will more closely match the actual measurements. This new point is used in the next iteration of the algorithm. At each iteration, the difference between calculated and actual measurements is expected to be reduced, and when this discrepancy falls below a predetermined threshold the point is considered a solution. (col. 9, lines 42-64).

In contrast, the calculated measurements of the claimed invention are derived from sets of reference measurements. Thus, Govari discloses at each iteration calculating $\vec{H}(\vec{l})$ ("a [9,3] matrix describing the theoretical field in each of the x, y, and z directions attributed to each of the nine radiator coils at the approximate sensor location") directly from electrodynamic equations. (col. 12 line 26 through col. 13 line 42). Although Govari may interpolate from a lookup table to determine a Jacobian value (col. 14 lines 41-47), and presumably interpolates from the set of calibration measurements to determine a calibration factor, these figures merely supplement measurements that are themselves directly calculated from electrodynamic equations, and are not derived from reference measurements.

This distinction points to a deeper difference, which more broadly demonstrates the current application's novel approach to the problem of inferring a location associated with a set of readings. While Govari's method remains essentially an on-demand calculation of electrodynamic equations, which is supplemented piecemeal by lookup data, the current application casts free of this conceptual framework by using as the basis for all calculations a precalculated matrix unifying theoretical and empirical reference data, calibration information, and derived data in a single formula (paragraph [0030], equation 6), representing a continuous field specially suited to the rapid calculations required for real-time positioning. (See paragraph [0031]).

Additionally, various dependent claims are further distinguished from Govari by the use of both trilinear (first-order) and second-order interpolations in deriving calculated measurements at a hypothesized location. To the extent that Govari's use of Jacobian and calibration data interpolated from lookup tables represents a derivation of calculated measurements from a set of reference measurements, Govari fails to disclose a derivation of calculated measurements from a set of reference measurements using a combination of a trilinear and a second order difference interpolation. The incorporation of second-order interpolations eliminates discontinuities in the calculated gradient of the field, and more accurately matches the actual field topology, which is beneficial for a convergence algorithm that is intended to provide calculations at a resolution well below that of the reference measurements, and that incorporates both field strength and gradient in its calculations. Thus, Govari fails to teach or disclosure at least one element of the independent claims and the dependent claims thereof, and therefore, the Section 102 rejection should be withdrawn.

E. Response to Section 103 Rejection of Claims 1-71 (Gilbert in view of Govari, further in view of any of Montean, Fabian, and/or Mate)

The Examiner rejected claims 1-71 under 35 U.S.C. § 103(a) as being unpatentable over Gilbert in view of Govari, further in view of any of Montean, Fabian, and/or Mate, on the grounds that "it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the calibration method taught by Govari with the method and apparatus of Gilbert in order to reduce examination time." In fact, combining the calibration method taught by Govari with the method and apparatus of Gilbert fails to teach a method common to the pending claims, exemplified by the identification element of claim 1, wherein the system identifies "a location associated with a set of calculated measurements that most closely matches the set of actual measurements wherein the set of calculated measurements is derived from the sets of reference measurements." In contrast, a combination of the calibration method of Govari with the method and apparatus of Gilbert would merely yield a method of selecting one among a set of *calibrated* reference measurements.

While the Examiner might be attempting to characterize the current application as a combination of the *search* method of Govari with the method and apparatus of Gilbert, the Examiner has failed to provide suggestion or motivation from the art or from a person of ordinary skill in the art to have made this combination. More specifically, Gilbert does not suggest the incorporation of an iterative descent algorithm. Govari does not suggest the incorporation of a closest fit match to a set of reference measurements. Each reference takes a completely divergent approach, and there is no suggestion in either reference that a combination of the two methods would be either beneficial or feasible. Indeed, the specification of the current application is substantially devoted to a detailed explanation of the method of deriving calculated measurements from reference measurements, and the justification for doing so. The current application teaches a novel and non-obvious synthesis and expansion of two previously incompatible approaches, and thus rejection under 35 U.S.C. § 103(a) was improper.

In view of the foregoing, claims 1-71 are patentable under 35 U.S.C. § 103(a) over Gilbert and further in view of Govari. Moreover, Montean, Fabian and/or Mate do not overcome the shortcomings of Gilbert or Gilbert further in view of Govari with respect to claims 1-71. Claims 1-71 are accordingly patentable over the combination of Gilbert, Govari, Montean, Fabian and/or Mate for the reasons explained above. Thus, the applicants respectfully request withdrawal of the rejection of claims 1-71 over the combination of Gilbert or Gilbert further in view of Govari, Montean, Fabian and/or Mate.

In view of the foregoing, the pending claims comply with the requirements of 35 U.S.C. § 112 and are patentable over the applied art. The applicants accordingly request reconsideration of the application and respectfully submit that the pending claims are in condition for allowance. If the Examiner has any questions or believes a telephone conference would expedite prosecution of this application, Examiner is encouraged to contact the undersigned representative.

Dated: 9.20.07

Respectfully submitted,

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